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UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

ROLLA METALLURGY RESEARCH CENTER

VAPOR DEPOSITION OF TUNGSTEN ON ROCKET NOZZLE INSERTS

Monthly Report of Progress
on Order No. IPR SP-9-60-3

for

Special Projects Office
Department of the Navy
Washington 25, D.C.

Report No. 14
Date June 1961

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Abstract

A second beryllia nozzle insert was coated with tungsten. The deposited metal was rough and lacked uniformity. This condition was owing, in part, to difficulty in controlling a slow flow rate of heavy-density tungsten hexachloride vapor. The tungsten-coated beryllia substrate had a transverse crack. Beryllia exposed to reactant gases showed some corrosion.

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Department of the Navy Order No. IPR SP-9-60-3

A. Background

On February 5, 1960, an order numbered IPR SP-9-60-3 was issued by the Department of the Navy, Special Projects Office, Washington, D. C., to the Bureau of Mines, U. S. Department of the Interior, Washington, D. C. The order covered the lining of rocket nozzle inserts with tungsten by vapor deposition from tungsten hexafluoride. The Aerojet-General Corporation, Sacramento, Calif., or firms designated by it, were to supply the machined nozzle inserts. Technical coordination of the work was assigned to the Aerojet-General Corporation, and all components produced under the contract were to be delivered, ultimately, to this corporation.

Six graphite nozzle inserts have been received and coated with tungsten. Five of these coated inserts were returned to the Aerojet-General Corporation for evaluation and firing tests. The other insert was cross-sectioned and examined metallurgically at the Rolla Metallurgy Research Center. The results of the firing tests were given in Monthly Progress Reports No. 5 and No. 9.

Three beryllia nozzle inserts and four beryllia-tungsten inserts have been received from the National Beryllia Corporation,

Haskell, N. J. Two beryllia inserts have been lined with tungsten. One was cross-sectioned for evaluation, results of which were given in Progress Report No. 13. Some transverse cracks were noted in the beryllia substrate.

Four subscale graphite nozzle inserts have been received from the Atlantic Research Corporation, Alexandria, Va.

B. Program Objectives and Scope

The objectives of this work are outlined in Monthly Progress Report No. 1 and in the Contract bearing Order No. IPR SP-9-60-3.

C. Program Status

A temperature standardization test was completed on one beryllia insert by means of a short reaction tube within a furnace. The insert was then coated with tungsten. The tungsten deposit was very rough. A contributing factor to this roughness was difficulty encountered in controlling the flow of tungsten hexafluoride from its container. The gas was emitted in spurts, causing an erroneous flow rate. The relatively small size of the insert required a low and carefully controlled rate of flow of reactant gases. This was difficult to attain with the heavy-density, low-pressure tungsten hexafluoride.

After the deposition cycle for tungsten was completed, the temperature of the reaction tube containing the coated insert was cooled very slowly to room temperature. This was done to lessen thermal shock and reduce thermally induced stresses. A transverse

crack formed in the beryllia substrate. The flat surface abutting the small cone showed some corrosion.

Arrangements have been made to coat a third beryllia insert with tungsten.

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